

XTAL SET SOCIETY
Books, Kits, Parts
YOUR NOVEMBER 2014
NEWSLETTER IS ENCLOSED

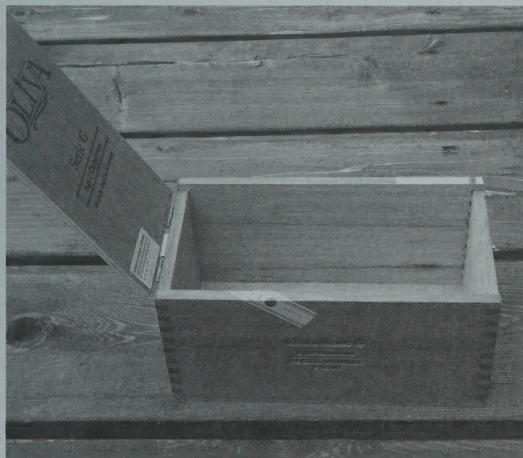
GETTING BACK TO BASICS

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XTALSETSOCIETY

Cigar Box Radio Contest

Build a cigar box radio and submit your picture, schematic, and any other information of your choosing. The Crystal Queen will determine the two best to be displayed in the March 2015 newsletter.

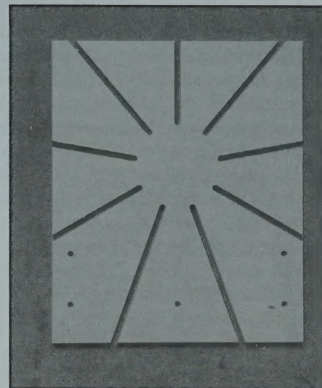
If you do not have access to a cigar box, go to our website and see our specials page where we show the boxes we have found or send me your order for it.



Oliva Ciger Box \$5.95

Spider Coil Form

This 5 by 6 by 1/8th inch ABS plastic form includes nine NC punched radial slots and five mounting holes. The inner diameter is 1.6 inches and the outer diameter extends to the edge of the form, 5.0 inches. This size supports 250 uH coils (good for the AM band) when used with #22 or #26 enamel, or 150/45 Litz wire using 56 turns of 150/45 Litz, with a 1.6 inner diameter and 4.2 outer diameter. Weight of the form itself is 2 oz. An instruction sheet including formula and table ships with the form. In addition, you'll find the spider formulas for number of turns for a given inductance on our formulas-calculators web page on our main site, www.midnightscience.com #22 and #26 enamel coated wire and 150/46 Litz wire are also listed on our parts page on the web. Spider Coil Form Cat #SpCO \$9.95 each.



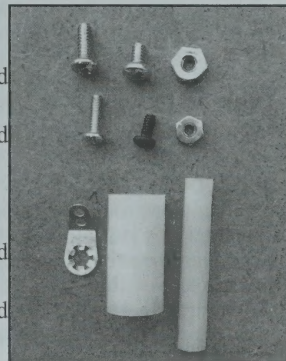
Connector Assortment

The assortment includes:

- 6, 6-32x3/8 inch Phillips-head screws,
- 6, 6-32x1/4 inch Phillips-head screws,
- 12, 6-32 hex nuts for the above,
- 6, 4-40x3/8 inch Phillips-head screws,
- 6, 4-40x1/4 inch Phillips-head screws,
- 12, 4-40 hex nuts for the above,
- 6, #6 solder lugs,
- 2, 1-inch by 1/2 inch nylon shafts with interior 1/4 inch opening,
- 2, 1.5-inch by 1/4 inch nylon shafts.

You can use a screw, solder lug, and hex nut to provide a ground connection on the frame and rotor plates of our air variable capacitors. You can use a pair of the nylon shafts by drilling and tapping two holes in the larger shaft for interconnection with the cap shaft and the smaller nylon extender. This enables you to mount the cap away from the front panel.

Cat# Connect assort 3.95



THE XTAL SET SOCIETY

e-mail: xtalset@sunflower.com

We are dedicated to once again building and experimenting with radio electronics, often—but not always—through the use of the crystal set, the basis for most modern day radio apparatus. This newsletter helps support our goal of producing excellent quality technical books that encourage learning and building. To join the society and receive one year of the bi-monthly newsletter, remit \$14.95 to The Xtal Set Society, Canadians, please remit US \$15.95. Outside the US and Canada please remit US \$21.95.

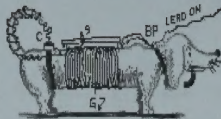
Please send articles and correspondence to the address below. NOTE: Unless otherwise stated, The Society assumes that the material you supply is fit for print (free of copyright or other infringements) and that by your submittal you have given us your permission to print the material without restriction.

Founder & Columnist—Philip N. Anderson, WØXI

Editor & Queen Mum—Patricia, NØGZZ

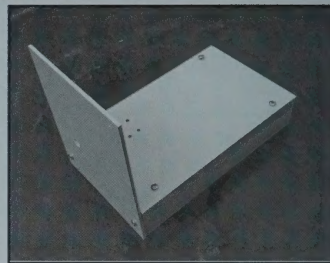
Columnist—J.K. Fenton

Columnist—Dan Petersen, W7OIL



ABS Panel and Chassis Kit

This kit, includes two precut ABS (low-loss) panels, 5 x 6 x 1/8 and 5 x 8 x 1/8th inches; two wood rails each 1.5 by 3/4 by 8 inches long, and six wood screws. No holes are predrilled in the panels or rails. The kit includes mechanical



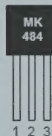
drawings showing dimensions and locations for the holes, including drill-hole patterns for the shaft and mounting of our 365 air variable capacitors. ABS Panel Assembly Kit, Cat #ABSPAK, \$9.95.

5x6x1/8 ABS Panel, Cat#ABS6 \$ 3.95

5x8x1/8 ABS Panel, Cat#ABS8 \$ 3.95

MK-484 TRF AM Radio Chip in TO-92 Pack

The MK484 is an offshoot of the famous Ferranti ZN-414 and is a tuned radio frequency (TRF) radio in a small TO-92 transistor-like package. Combined with (these parts not included) three resistors, three capacitors, an ear phone, 1.5V battery, tuning coil and tuning capacitor, you can make an AM receiver for the AM band and up to 3 MHz. See our article in the July issue of our newsletter for a circuit example with details. Suggested schematic with parts list sent with each IC (chip). Cat# XSMK \$2.49



Mini MK484 Radio Kit

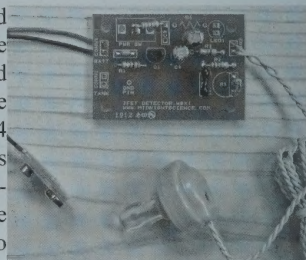
No antenna or ground required!

This “mini” kit is a subset of the MK484 AM Radio kit and uses a small portion of the printed circuit board of that kit. The MINI features the MK484 IC, a ferrite rod antenna, a 1.5 volt regulator, a handful of resistors and capacitors, an on-off switch, variable capacitor, panel, chassis, and crystal radio earpiece. The set does not need an antenna or ground since it includes the ferrite rod; does not need a volume control since it has built in gain control, and the earpiece takes the place of headphones. You supply the 9V battery. The radio is set to tune the AM band. MK484 mini \$69.95



Infinite Impedance Detector Kit

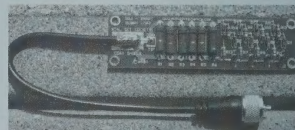
This kit includes parts and a small PCB to substitute a JFET circuit configured as an infinite impedance detector for the usual 1N34 diode detector. With this replacement, your crystal set will generate more volume and reduce audio distortion. Historically this arrangement was used with a triode tube in early AM radio sets. Ideal for those wishing to listen to AM with improved audio linearity. Kit replaces the diode detector in your crystal or TRF set. Assembly time is about one-half hour. CAT # XSIDK \$19.95.

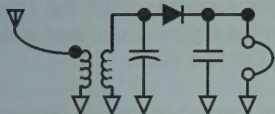


XS-SDLK (Self Powered) Smart

Dummy Load- 10 Watts.

For QRP Amateur Radio use. This kit and our passive CW filter kit were inspired by our enthusiasm for non-powered - no batteries - electronics. The “smart” dummy load, assembled on a 1-1/4 by 4-1/2 inch PCB, features a 10-watt dummy load with power levels achieved denoted by four LEDs. The circuit includes six 3-watt metal film resistors, four detector diodes, four zeners, four LEDs, and bias resistors. The four LED circuits denote power achieved: 1, 2, 5, or 10-watts. The signal measured supplies the power. No batteries Mom! Assembly time is about 25 minutes. Coax with PL-259 connector not included. XS-SDLK, \$19.95.





The Xtal Set Society Newsletter

Volumn 24, No.4

November 2014

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- * Xtal Corner: Member Correspondence

Now Hear This!

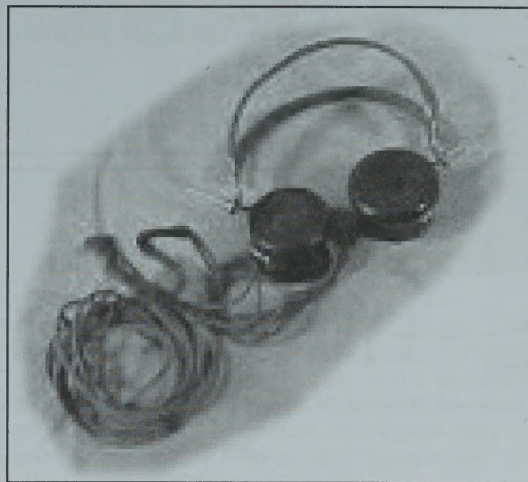
by Dan Petersen, W7OIL

Elmer Oldham was engaged in one of his favorite activities, napping in front of his favorite HRO senior receiver, "cans" on his head and his hand ready next to the "bug" he liked to use. In his reverie he hears "NOW HEAR THIS! GENERAL QUARTERS! ENEMY SPOTTED!!" He awoke with a start and went for the bug when he realized that he had been dreaming. "Well", he thought, "So much for the Big War." Then he saw The Young Ham's head sticking up through the trapdoor in the floor of the attic and he invited Robin up. "You're sweating, Mr. Oldham" was Robin's first observation. "Just a sec." Elmer replied, "I need to take these cans off - they start hurtin' after a while!"

"Cans?" the Young Ham asked. "Yeah", Elmer said. "Baldy's - Headphones" - "You know you are a real radio operator when you can pull off a full watch with these on without getting a headache. My childhood nickname was "Jughead" because my ears stuck 'way out - until my stint in the Navy. Spending the War with cans flattening my ears took care of that nickname." He scratched one ear that was now permanently flattened against his head.

Headphones, along with the almost absolute slang term "cans" have been a staple from their invention early in the 20th century to today's "MP3" players. They take many forms but they all serve the same purpose - to conduct sound directly to the user's ears efficiently. They also provide a degree of privacy for the wearer but the real advantage is that they do not require much energy to work. This is where their use with crystal and regenerative radios comes to the fore.

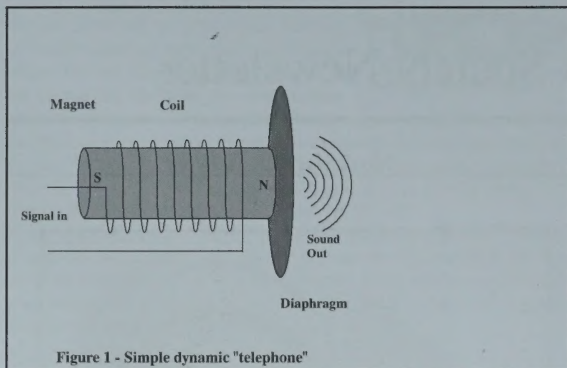
The idea of the "telephone transducer" was popularized by the experiments and inventions of folks like Edison, Elisha Grey and A. G. Bell. In 1910 Nathaniel Baldwin in Utah



developed two of these transducers incorporated with a headband and sent a prototype to Lt. Comdr. A. J. Hepburn of the U.S. Navy. Hepburn found them very useful and ordered more. Baldwin could only furnish ten at a time as he was building them in his kitchen! Nathaniel Baldwin's phones went on to become one of the most premier headphones of the mid-century and whose 'phones are highly prized to this day.

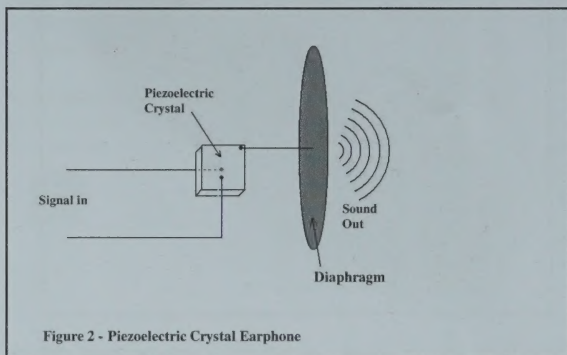
So, Where to begin? First of all, how do they operate? A headphone converts electrical energy into mechanical motion which in turn generates sound energy. The earliest and most common form was the "dynamic" headphone or "telephone" as it was known early on. The electrical energy was passed through a coil wound around a magnet. This creates a "biased" electromagnet which attracts magnetic materials such as an iron diaphragm. The diaphragm is very thin and will deform depending on the amount of current passing through the coil. If the current varies at an audio rate the diaphragm will follow the changes in current and create sound waves. The coil can also be connected directly to the diaphragm with the coil "floating" in a magnetic field. Figure 1 is a representation of how they are made.

Another version is the "piezoelectric" or "crystal" headphone. Figure 2 shows how the "innards" are arranged. This type utilizes the property of a specially ground crystal. The piezoelectric effect is that when a voltage is impressed



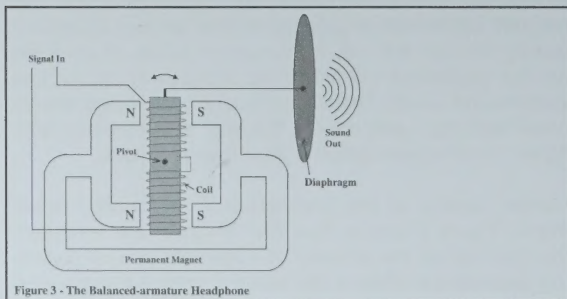
use this concept to achieve their superior sensitivity. They are however more scarce than the Figure 1 dynamic style and more expensive when you DO find them.

My reader may have heard of “sound-powered” phones. When I was a kid there were barrels of them at the war-surplus store for just a couple of bucks each. They were heavy and uncomfortable not to mention looking “dorky” so they stayed in their barrels. The same type of “element” is used both for listening and talking. Talking into the element generates a voltage that the “receive” element converts back to sound. Batteries not included as batteries are not needed. No power source other than your voice. These are still used on board ships since as long as there is wire continuity between the elements they will work. These phones are prized now for their exquisite sensitivity but you need a fat wallet to get a pair.



on two certain points on the crystal the crystal will deform more or less depending on the voltage applied. The crystal is mechanically linked to a diaphragm. The vibrations thus induced create sound waves. These phones can be very sensitive but are also delicate. Dropping them on the floor is not recommended but they are quite rugged enough for normal use.

A third type, and considered by many the “holy grail” of headphones is the “balanced armature” headphone. Figure 3 reveals that this style is more complex than the other two but it pays off in increased sensitivity than the other “dynamic” style. Note that the coil is wound around a core that is supported by a pivot and suspended in a magnetic field. Baldwin headphones and “sound-powered” phones

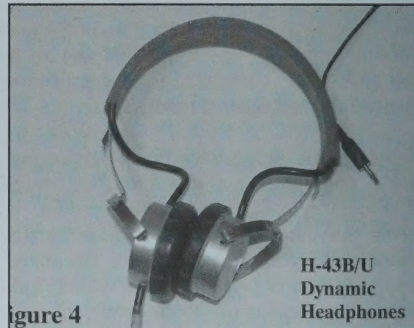


A Word or Two About Impedance:

The term “impedance” is bandied about a lot. High-impedance is the word we are looking for. Many ‘phones are rated at about 2000 ohms. This is not the DC resistance but a combination of that and the reactance at a particular audio frequency. Hence it can be a little vague. The “earbuds” used in modern music players are low to medium impedance meaning usually less than 600 ohms. Not good for crystal radios. Crystal earphones are essentially infinite impedance. Electrically they “look” like a capacitor so a parallel resistor is used to act as a resistive load. Without this resistor, usually 10,000 to 68,000 ohms value, the audio will be weak and distorted. As dynamic and balanced-armature headphones DO have a DC resistance they do not require a load resistor.

Representative Types:

The most simple type of dynamic headphone can run the gamut of “darn good” to “deaf as Beethoven”. I have found that the “Trimm Dependable” dynamic headphones are dependably mediocre. They are OK but nothing to write home about. “Telex”



phones are usually low impedance but I did at one time have a 2000 ohm pair. I wasn't impressed. Much better are the H-43B/U headphones I picked up from eBay a few years ago. These were touted as “Korean Army Headphones”. They are actually 3000 ohm units made for use with a Radiac Geiger Counter. They are quite sensitive but they come with

a caveat - do NOT attempt to take them apart. A friend of mine did and ruined the unit. I paid \$30.00 several years ago for a "new in the bag" set.

Next on the list is the Nathaniel Baldwin "Type-C" balanced armature headphone. A clue that they are balanced armature is the deep "cans" containing the elements. The interior magnet takes up more room than a simple dynamic pair like Figure 4. For headphones

that are not in the "sound-powered" category they are excellent. The pair I own were in pretty poor shape when I got them. I made a new deerskin headband and polished off the bird-droppings and cleaned dead spiders out of the "cans". A new cotton-covered cord and they are good to go! If you see Baldwin phones at a fleamarket they would be well worth picking up.

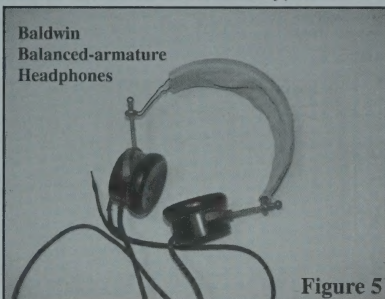


Figure 5

The sound-powered headphone - The one representative I have is a pair of British "DLR-5" headphones. Reputedly made by Mullard (and probably others) they are WW2 vintage. The "DLR" is rumored to mean "Dynamic Low Resistance" and they do have a low DC resistance. My pair reads 56 ohms but that does not mean they are low *impedance*. I find they are best used with a hammond organ impedance matching transformer where you can juggle taps to get the best impedance match to your set. They are VERY sensitive. In Figure 6 I am holding them by their fabric headband. The stiff wire around the back is to hold the cans apart while



you put them on. It seems strange but they are quite comfortable when you get them arranged on your head. These can be found on the internet but bring a wallet full of money.

And Now, Closer to Home...

There are a couple of sets I keep here that are pretty easy on your wallet and well worth the money. The first is from our own Xtal Set Society in the form of the Crystal Earphone, illustrated in Figure 7. Note I call them "ear" phones and not "head" phones. These are inserted into your ear-canal rather than pressed to your head with a headband. They were originally developed in the 1950's for hearing aids. The best

ones are the old Japanese made ones but the current ones are practically as good. When I use them I use two. I find they cut out outside noise and kind of balance the sound in the middle of my head. Remember to use them with a load resistor or you will find the audio weak and fuzzy. This is caused by the fact that electrically they are a capacitor and will charge up. It sounds like someone talking with a mouth full of mashed potatoes, which may not be a bad analogy. In the sensitivity department they are pretty dog-gone good. These little beauties are available from The XSS catalog online or in the "Newsletter".

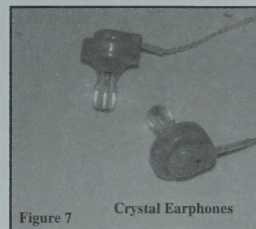


Figure 7

Last on the list but certainly not least is the "Peebles Originals" piezoelectric headphones. Figure 8 shows and if they look like a pair of hearing-protectors you are right. Through the genius of Peebles engineering he takes this meek pair of hearing protectors and inserts high-quality piezoelectric elements. The result is a great pair of ear-phones that nears the sensitivity of the rare sound-powered phones. They are also very comfortable and block out external noise like - well, a pair of hearing protectors! They are available through the "Peebles Original's" website.

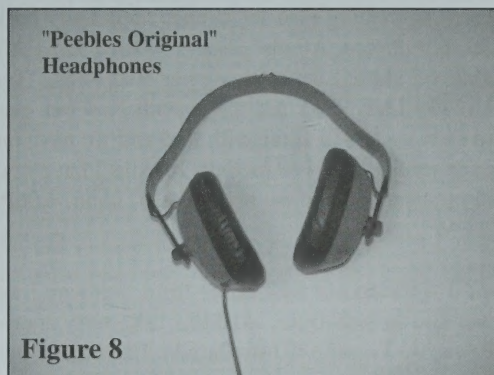


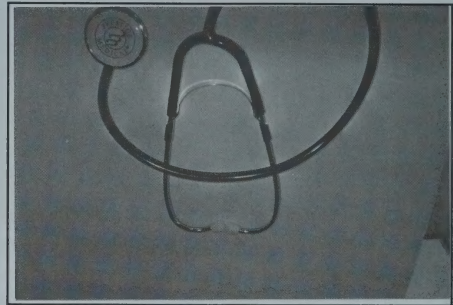
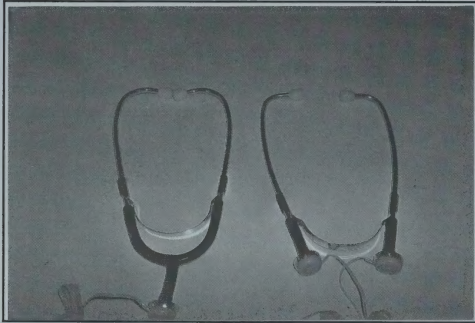
Figure 8

If you are trolling for headphones at a fleamarket it would be handy to take an ohm-meter with you. You can check the DC resistance of them and see if you hear a "click" in the elements. Choosing the right headphone is a personal thing. I know one person will say that such-and-such a pair ain't worth the effort to throw them out while someone else will say that same make is the best they ever used. Get what works best for you.

Happy experimenting!

Editor note:

The pictures here are from Larry Jeffers. It seems that Dan is not the only one thinking of earphones. Larry says the single phone works well, but the double in series is great!



The Multi Loop Antenna

For those of you who do not know me I am Chuck Young, KA8WOT. I have a Beagle named Lady and a male cat named Red. Every day I ask Lady if we should have this for supper today. If Lady does not say anything, after three tries, I pick something else for supper until Lady barks, "Yes." at that choice. Almost always when I am asking Lady what we should have for supper Red cries, "Tuna fish." Usually Lady does not agree with Red but every now and then Lady will agree with Red and we have tuna fish for supper that day. For medical reasons I have to eat and take medications and eat at: 8:00AM, noon, 4:00PM and 8:00PM.

Lady and I were on our way home from Skidway Lake, where we had helped Dale, AB8BU, SK, with another Mills Township Fourth Of July Parade. Lady and I were bouncing around ideas on how to make a fullwave loop antenna better. As we were going down Pinnacle Hill towards Pinnacle Bridge over the Rifle River Lady asked, "What about the feeding of the fan dipole?" That was it! Lady had hit the nail on the head. We set out to test the theory.

In the fan dipole you have a: 160m dipole, 80m dipole, 40m dipole, 20m dipole, 15m dipole and 10m dipole all fed at a common center insulator. If you feed a fan dipole

with good 50 ohm coax, it will work very well. If you feed a fan dipole with 75 ohm coax, running fifteen- hundred watts into it will not work as well as one-hundred watts into a dipole fed with good 50 ohm coax.

As an experiment we put up some posts made of two eight foot two by fours in the ground two feet leaving the top of the post six feet up. I had a fullwave loop and dipole for 160m up and I moved the fullwave loop over to the top of the posts. Now I knew the fullwave loop would receive better by two S-units better than the halfwave dipole did. With the tops of the 160m fullwave loop only six foot off the ground that fullwave loop was receiving two S-units weaker than the halfwave dipole. It appeared that the fullwave loop just had to be further off the ground so we went to eight feet. Not high enough. At ten feet high the fullwave loop started working like it should. We chose to run the posts tops up to thirteen feet six inches off the ground since that was with only six inches of overlap on each eight foot sections. Changing the feed point of the Multi Loop Antenna did not have any effect on the radiation pattern. A rectangle acted like a rectangle and a square acted like a square.

All the lower sections of supports are made the same way with two eight foot two by fours. Opinions as to what to use what to stop bugs abound. My personal view starts with a good oil based enamel paint. Although we were

only going to put two foot of the post in the ground I decided-to-paint the bottom three feet of the post-The first two coats of paint I put on before the bottom two eight foot two by fours were put together. The most economic way to join these two by fours is with four sixteen penny nails.

Put the two by fours together to form a T. About a half of foot, six inches, fifteen centimeters, from the bottom and from the top put a nail in to hold the top of the T to the vertical part of the T. About two foot, twenty-four inches, sixty-one centimeters, from each nail you drive your other two nails. Once you have made the T you need to paint the bottom three feet of post with three more coats of your good oil based enamel paint. Five coats of a good oil based enamel paint will put a really bad taste in most bugs that live below ground so they will protect very well. For protection on something with enamel paint you want the coats to be as thick as you can make them but they need to be fully dry before the next coat on top of it. The spots where the nail heads are you should make sure there are a full five coats on them too.

The top sections are done almost the same way. The closes the top section is to the ground is five and a half feet. One of the places you want a rail is in the center of the eight foot long section. The top sections for the 160m and 40m fullwave loops are made the same way. The reason the 40m top sections are made as strong and the 160m fullwave loop is because the 40m top sections hold up the: 40m, 20m, 15m and 10m fullwave loops inside them. You need eight of the top sections unless you want to do something other than a square or rectangle for your Multi Loop Antenna. For several years I ran a fullwave loop in a triangle with my major nulls to the north and south. Every time I checked in to this Net there was this Ham the lived due south of me and he could never hear me even with fifteen-hundred watts or power. Then one day Lady and I decided that we should make that fullwave loop into a square so we did. I had the power turned down to five watts on my Kenwood TS-2000X for testing. That Ham to the south of me was taking the checkins for the Net and I was sure he was not going to be able to hear me so I keyed the microphone and tossed out my call letters. Right off the bat, first try, that Ham to the south on me heard me. From that time on, unless there was a thunderstorm someplace, I only ran five watts on that Net. Later on several Hams said, "You have the weakest signal on the band but you are

loudest person on the band." Because of the noise in here, when the air conditioner is on, I get real close to the microphone and talk a little louder.

You will need to cut nine inches, three-quarters of a foot, twenty-two point eight-six centimeters, off of each of the eight two by fours. On the other eight two by fours you mark each one of them six inches, one half foot, fifteen point two four centimeters, up from one end. Take one of the two by fours with the nine inches cut off it and make the vertical piece of the T section. Line up the end of the shorter two by four so one end of it is at the six inch mark on the horizontal part of the T second and nail it in place. Go to the other end of the T section and the vertical part will be three inches from the top, nail it in place. You should use at least five sixteen penny nails to hold the top T section together. If you want to use lag bolts in place of sixteen penny nails, they will work well here but use a flat washer under their heads.

Joining the top section to the bottom section you might need a little help holding them in place to get them started. For each post you will need: two one-quarter inch bolts long enough to go through both thickness' on your two by fours plus a half inch, two nuts for these bolts, four flat washers and two lock washers. You will need a quarter inch drill long enough to go through both thickness' of the your two by fours. On the bottom of the top section, the end with six inches of overhang, mark one inch up from the bottom and one-half inch in from each side, this is where you will drill your holes for the bolts.

You will need a couple of the nine inch blocks that you cut off to make the shorter pieces. If you happen to have a bench sixteen feet long, use it. If not, a garage floor will work just fine. You can use a relatively flat piece of ground for this part.

Place a bottom section on the ground. At the top of the bottom section place the bottom end, the place where there is six inches before the T section starts, so that the six inches overlaps the bottom section: Place the two nine inch long blocks so each one of them is flat, one about a foot up from where the two sections meet and the other about a foot from the top of the top section.

Get the drill ready. While balancing the bottom T section place the top T section so it is on top of the bottom section. While pushing the two balanced T sections together drill

the holes in the places that you have marked. Just as soon as the hole is drilled put in one of the quarter inch bolts and a flat washer. Then drill the other hole and put the bolt and flat washer in it. One guy decided that he was going to use a six foot level to make sure the sections were straight but it took three more people to deal with the six foot level. Take a sixteen penny nail and put it in the middle of the top section five inches up from the bottom of the top section and drive it home there. If you wish the use a lag bolt in place of a sixteen penny nail, that will work just ~e. ~ut a: flat washer, a lock washer and a nut on each of the bolts. Only tighten the nuts until the flat washers are even with the wood. Any tighter is not good for the wood.

On the top three inches of the overhang you need the cut slot for your sting or rope that you are going to use. I use number eighteen nylon string. It will hold up the 160m fullwave loop and when the wind is blowing so hard that it blows out a propane torch, it is twenty degree below zero with a wind chill factor that will make you think you are at The South Pole I find it a lot easier to tie the string back together again than it is to solder the antenna back together. Oh yeah, he string breaks before the eighteen gauge copperweld antenna wire that I use. I have a crosscut saw that leaves just a wide enough path that the string I use just fits into it nicely. If you wish to use quarter inch rope for you 40m, 20m, 15m and 10m fullwave loops you should probably use a piece of two by four at least four inches long on the top of the 40m, 20m, 15, and 10m fullwave loops sections.

Now that you have one post for the 160m fullwave loop or the: 40m, 20m, 15m and 10m fullwave loops you have to decide what you are going to do with it. My fist posts I did nothing but paint the bottom three feet to keep the bugs away. You need to address the problems of rain, snow, sleet and other weather related things like sunshine in the summertime. If all you are going to do is seal it, use the best sealer you can buy in liquid form, not the spray can. With a two inch paintbrush put a good heavy coat of sealer on it in the morning. Wait until the next morning to put the second coat of sealer on it. Wait until the next morning to put the third coat of sealer on it. Wait until the next morning to put the fourth coat of sealer on it. Wait until the next day to use them. If you follow these instructions, you will be glad you did.

I worked for this place that was going to add a machine shop to their building and when it came to sealing the

concrete the guy in charge of taking care of everything told them but buy the best sealer that money could buy. They took his advice and everyone was happy that the sealer they used. Several years later they needed to add on to the machine shop but they opted for the cheapest concrete sealer they could find. It made such a mess that they had to come in and take up four inches of the concrete and put down fresh cement. That time they spent the money for the best sealer money could buy and neve~ questioned the guy in charge of keep the place up again. That same goes for the wood sealers on the market. I know this guy who was talked into putting down this stuff on his deck that had a thirty year warranty to it, I told him to get the good stuff and he told be that was the best wood sealer in the world. Three years later he was ripping up his deck and had to put new wood down. I asked, "How did that sealer work for you." He was so mad that he could not talk. I tell the truth and people hate me for it. Same thing is with paint. The ninety-nine cent can of spray paint is not going to protect what you are going to want to protect it from. You have to choose: looks good or protects good. Protection for wood outside is with a paintbrush in the form of a good oil based enamel paint. The same paint you used on the bottom three feet of the post. A different color, if you like, but the protection will be there if you get a good five coats on it. I built my first 80m dipole antenna in 1964 so I have seen how things hold up. At one time, I was told, you had the replace your antenna at least every five years. It was not until I let an antenna go for ten years and when I went to use it again I did not have to do anything to it but check the SWR which was just fine.

Like with any antenna the higher you get it off the ground the better it will work. This is to get it off the ground high enough for it to work well enough to make your efforts worthwhile. One Ham decided that we was going to use four sixty foot towers he had to string up a Multi Loop Antenna with and he was so surprised that he did not believe his S-meter when compared to his dipole antenna on 80m. If you like a fullwave loop that has been put up and fed properly, you will love the Multi Loop Antenna. On the average day take the Ham who was pushing your S-meter to an S-five on your fullwave loop, he will be an S-seven on the Multi Loop Antenna. The S-zero noise on your fullwave loop will be even quieter on the Multi Loop Antenna.

The last time I was on 160m and there were static crashes that were pushing my S-meter to S-five on the Multi

Loop Antenna everybody on that frequency was getting of the static crashes, one Ham with a halfwave dipole said he was getting 30dB over S-nine static crashes. The weakest signal I was getting on them was an S-six so I could hear him very well. I do not have a 160m antenna up other than the Multi Loop Antenna so I could not switch antennas to see how it was working. I barrowed an 80m fullwave loop to put up so I could report on how the Multi Loop Antenna was working next to that. Then some Hams wanted me to put up a halfwave dipole for 80m just so I could report on that.

With the Multi Loop Antenna in a square the major nulls are: northeast, southeast, southwest and northwest. The major nulls are 4.2SdB deeper than the major nulls on the fullwave loop by itself In my opinion, I think: Kenwood put the worst automatic tuner they ever made in my TS-2000X. However my TS-2000X can tune the Multi Loop Antenna from 160m through 6m. I did not intend on using the Multi Loop Antenna on 6m but here is how it happened.

The TS-2000X has two HF through 6m antenna ports. There is a receive only HF antenna port that I have only used just to make sure that part of the radio was working right when I first got my TS-2000X which happened to be a gift from my mother. I was testing the automatic antenna tuner in the TS-2000X to see what it would tune on 6m with only five watts of power into the Multi Loop Antenna and there was a band opening on 6m. I heard this Ham calling CQ so, without thinking, I keyed the microphone and tossed my call letters at him. He could hear me. He gives me his QTH and I reach for the rotor control box so I can turn my homebrewed four element vertical yagi at him. As the rotor is turning my S-meter is not picking up any better like it should be because I was getting closer to being pointed at him with the beam. Then I remembered that I was only running five watts on the Multi Loop Antenna. Well he was horizontally polarized and when I did get the vertical yagi pointed at him he was stronger on the Multi Loop Antenna. I worked several Hams on that band opening and if they were horizontal I picked them up better and they picked me up better on the Multi Loop Antenna. Vertical was a different story, the four element vertical yagi worked better than the Multi Loop Antenna.

I have never been a fan of the GSRV antenna for the simple fact that using a halfwave dipole for each band would always out perform the GSRV antenna. Since I

have been using the Multi Loop Antenna is feels good to have an antenna that will cover from 160m through 6m is something that I have gotten use to. The major nulls are something that I can live with and that is the only down side of the project.

Feeding the Multi Loop Antenna is as easy as you want to make it. A good low loose fifty ohm coax is good and the automatic antenna tuner in the TS-2000X will handle that. I am using fifty feet of RG/8X If you wish to use 450 ohm twinlead, you will need a better antenna tuner than the TS-2000X has in it. If you use 450 ohm twinlead, you should put a PL-259 on the end of it and do not use a balun.

The Multi Loop Antenna is the best HF/6m horizontal almost omnidirectional antenna I have ever used and I have built every antenna that someone has come up with.

From the Johnson Smith & Co Catalog. Looks a bit like the Philmore detector we found.

Listen to
SPORTS,
MUSIC,
& NEWS
BROADCASTS!

Radio Detector
Complete With Crystal
This Detector is a radio to itself, as it is possible to get reception with it alone, provided you are within 25 miles of a broadcasting station (or up to 100 miles under very favorable conditions). All you need is a good outdoor aerial and an earphone and you are all set. It is completely assembled and wired, all ready for use.

Advantages of the Crystal Radio
An ideal bedroom radio. Simple to operate and has no operating costs. You can leave it "on" day and night for a month and it will still be in first class condition. Once you have it connected up, and this is simple, you have a radio that should give you trouble-free reception for a long, long time. No electrical connections and consequently it does not pick up electrical interference of motors, electrical devices, etc. Because it produces earphone volume it does not disturb others.

Radio Reception Positively Guaranteed
Includes the stand, crystal cup, stem with cat whisker, an ultra sensitive Philmore Radio crystal, and two terminals for wire connections, mounted on handsome base. Every set factory tested. Reception positively guaranteed.
No. 6590, Crystal Radio Detector, Price Postpaid..... **35c**

Folks,

I'm working on a classic hobby project and I'm stumped. (Isn't this how all great XSS mysteries should begin?) The project is an inductor tester that measures coils from 250 uH to 10 mH in one range. Great idea! This bit of genius comes from 73 Magazine, that wonderful font of simple but practical circuits.

I found the circuit in *Master Handbook of 1001 Practical Electronic Circuits,* the Bible of many hobby projects. Then I looked up the article by Jim Clack online (one page) and read it thoroughly several times. Unfortunately, the circuit description (as usual) is very terse. Some part data and even at least one potentiometer appear to be missing. The missing part data include the coil inductance, the operating frequency and both the transistor material and gain.

Mysteries are intriguing, as are fixer-upper radios. This is a mysterious, fixer-upper circuit. And it only requires one (unknown) transistor. Can it work? I thought I'd find out and then write an article for some technical magazine about my results. After all, the circuit "looks simple enough."

(How many misadventures have you started with those words?)

After hundreds of attempts, I still don't know. The circuit is a Hartley oscillator. I've tried various versions (both PNP and NPN). According to my freq meter, most of these circuits oscillate. I even built a couple of Colpitts versions. They work, too!

THE MEASURING CIRCUIT is what trips me. The transistor base also connects to chassis ground. I assume that this is a floating ground. Otherwise, assuming that the base connects to the battery negative, the oscillator would shut down. Such a connection actually shorts the base to the emitter. A connection to positive actually shunts the measuring circuit across the collector resistor. This connection could allow excessive current to flow through the battery and transistor. (I tried that, and didn't like it.) Also, the base already connects to the collector through the coil.

THE POT MYSTERY. I think that a 25K pot in series with a 1K current limiter should connect between the

unknown and chassis ground. I see this "zeroing" pot on the photo, but it's missing from the diagram. The idea of the pot is to emulate the "zeroing" pot on an ohmmeter: Short the leads and set the pot to maximum current flow. I figure that a 25K resistor at midpoint would allow about 1 mA to flow through the meter.

THE TRANSISTOR MYSTERY. I assume from the age of the article that the transistor is germanium. (I'm using a silicon device.) Then I *think* the maximum gain should be $(4.5 \text{ volts} / 100 \text{ ohms}) * \beta = 1 \text{ mA}$. Solving for β gives 45. The 1mA current value derives from the full-scale meter value, which is the necessary maximum base current. A silicon device *should* work fine, but might require voltage divider bias. This type of bias would be useful because...

(1) The Si device would have a gain greater than 45 (more like 200).

(2) The Si device can't operate on leakage bias. It doesn't leak as much as a Ge device does.

To get around Problem (1), I've tried an attenuating meter driver. I can set the baseline, but the circuit doesn't work.

To get around Problem (2), I've tried various bias resistors and methods: No bias, voltage-divider bias, and fixed bias. None satisfy.

THE INDUCTOR MYSTERY. I'm not using a loopstick. I've substituted Fastron, conformally coated coils. I think that these are similar to the ones that the XSS uses in one of its kits. Yet I also don't know what the "standard loopstick inductance" is. Or is there one? I'm talking about an inductor from a *very simple,* "All American Six" pocket radio (*not* a Zenith Transoceanic). I always thought that loopsticks ran in the range of 240 uH, to resonate with a 365 pF capacitor. I used this value, but to no luck. (The circuit oscillated at about 800 kHz, but gave no useful readings. All coils read like a short.)

Then on the Web, I found a loopstick with an inductance of 680 uH! I substituted this value. The 150 pF capacitor in the circuit would then cause oscillation at about 498 kHz (by my calcs). But all coils *still* read like a short

(near full scale, just like the 25K VR1 setting for full scale).

CIRCUIT OPERATION. The best I can figure, this is the simple circuit theory: First, we set Pot VR1 for maximum deflection of Meter M1. That is, 1mA base current with shorted meter leads. Now we unshort the leads, connect Unknown Coil LX1 and press the TEST button. Diode D1 prevents meter deflection while Transistor Q1 is off. Otherwise, you'd be reading the power supply. Yet whenever the oscillating transistor is on, Diode D1 allows current to pass through Unknown Coil LX1. Then the coil reactance adds to the pot resistance of VR1.

A small-value coil reads nearly 100 percent of the meter M1 value (1 mA). In this case, there is almost no attenuation of the RF signal. A large-value coil is a completely different story. It significantly attenuates the RF signal on Q1. The meter will read much less than 100 percent of its maximum value.

The meter M1, being mechanical, can't respond fast enough to record RF ripple. For this reason, M1 is a crude ripple filter for Diode D1.

My questions are these...

=====

- (A) Is there a "standard" loopstick inductance value for pocket, plain-vanilla radios?
- (B) Please: What is the value?
- (C) Is my idea of the floating ground correct? (That is, the unknown connects through a 25K pot to Q1 base.)
- (D) Can you imagine this circuit working with a 2N3906 PNP (or 2N3904 NPN) transistor?
- (E) What is the correct bias method for such a general-purpose transistor in this circuit?
- (F) What should be the oscillation frequency for measurement of coils between 250 uH and 10 mH?
- (G) Would it be much lower than the natural oscillation frequency of the smallest coil and the 150 pF cap?

Thanks for sharing my mystery with me. Now we return you to your normally scheduled programs. (NBC chimes.) James T. Hawes AA9DT

Revisiting the Henry-O-Meter

By Phil, WØXI

James Hawes, AA9DT, sent us a note a while back about the "Henry-O-Meter" article that appeared in 73 Magazine forty plus years ago written by WA8MLP. We have to agree with James about the wealth of information packed into those old 73 back issues; Wayne's magazine is no longer published and that's too bad. I simulated the CB (common base) PNP oscillator circuit described using LTSpice (a software program) and could not get it to work either. I suspect there are wiring errors in the original schematic and some component values were missing. Still, the idea is interesting. I've redrawn the schematic in the article without change as Figure 1.

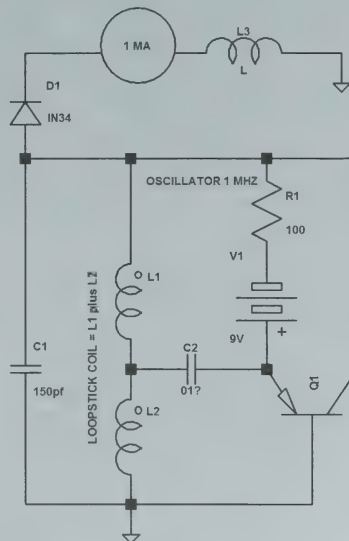


Figure 1

Here's the author's idea behind the meter. "The Henryometer is based on the formula for inductive reactance. This states that the two variables which control reactance are frequency and inductance. Since the meter supplies the frequency, inductance will control reactance. Thus the circuit is a reactance or AC ohmmeter." Saying this another way, if we apply an RF voltage (a steady sine wave) of a given frequency across a pure coil, the resulting sinusoidal current will be dependent upon the voltage and coil inductance. Given that the voltage applied is constant (in peak to peak value and frequency), the current obtained will go down as the value of the inductance is increased

and vice versa. This relationship of L (inductance) and I (the current) could then be used to label the panel of the milliamp meter-with inductance values.

Here is the author's test procedure. "To test a coil, connect it across the terminals. Momentarily short the leads and adjust the control (we assume he means the pot) for zero, or one mA, undo the short and read the value (in uH) indicated." The picture of his homebrew unit showed his MA meter face marked up for uH values from 0.25 to 10 mH.

Assuming the original frequency of operation was 1 MHz and C1 was 150 pf, the total inductance of the loop stick (coil) when seem to have been ~ 170 uH, or 85 uH per section for L1 and L2. The text indicated that there was a pot somewhere in the circuit; and, I assume that it applies to the only resistor in the circuit, R1. James thinks it might have been a pot placed in series with the 1 MA meter (but left out of the schematic). The author used a DC MA meter to measure the current and in order to do that he put a 1N34 diode (D1) between the oscillator voltage source and the meter and coil under test.

Before filing these notes, I decided to simulate NPN and PNP versions of the Common Collector Hartley Oscillator, using LT-Spice, and did get them to work. These schematics are shown in Figures 2 and 3.

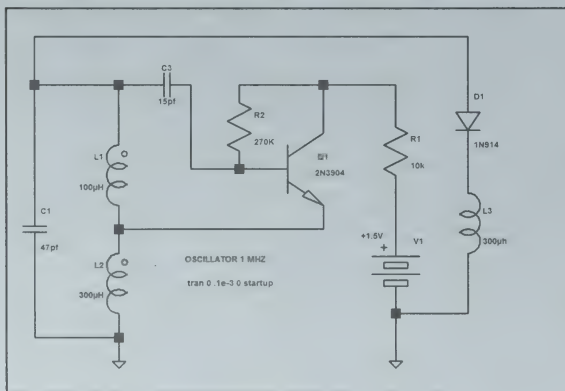


Figure 2

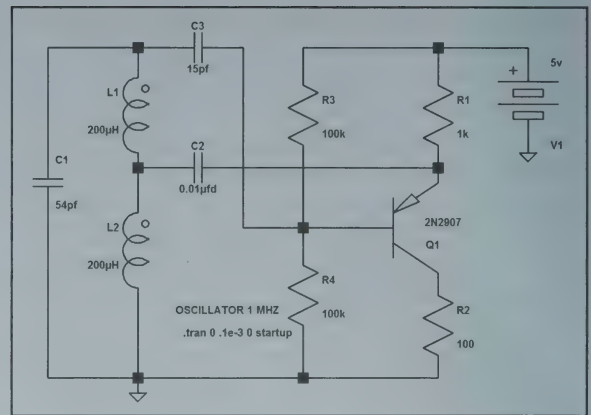


Figure 3

Let's take a closer look at the PNP oscillator, Figure 3. The feedback for oscillation is controlled by the ratio of L1 to L2. The smaller L1 is compared to L2 the less the feedback and the smaller the output voltage (at the top of L1). The frequency is set by L1, L2, C1 and a small amount of capacitance from coupling cap C3. A slight tweak in C1 gave me the 1 MHz of oscillation I was after. The simulation is also interesting in that the trace in figure 4 shows how the oscillator comes up to speed after battery power is supplied.

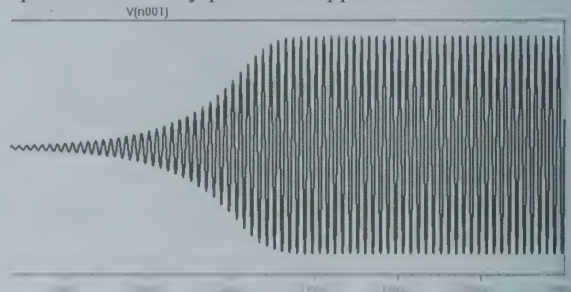


Figure 4

I then attached a diode and inductor in series (like that of Figure 1) to see what the current through a test inductor would look like. As I suspected, the waveform was distorted. I think the original circuit for measuring the current in the inductor via a DC meter needs to be changed if possible.

Given that, I decided to measure the current using a signal generator, sensing resistor, and oscilloscope. Most coils used in AM band circuits are small and fall

into the 30 to 300 micro-henry (uH) range, I decided to measure a 220 uH and a 150 uH, which are standard values and in my stock.

My measurement circuit consisted of a coil in series with a 10 ohm ¼-watt sensing resistor, as noted in Figure 5. The leads coming from the generator connect to the left side of the coil and to the ground strip at the bottom. I then added the 10 ohm resistor in series with the coil. The far right side of the resistor is then connected to ground. The jig is a simple series circuit starting with the signal generator, set at 8 volts peak to peak (VPP) at a frequency of 1 MHz. The generator scope trace is shown in Figure 6. The oscilloscope was then used to confirm the voltage at the node between the coil and resistor, i.e. across the sensing resistor and ground. The voltage was 60 mv so the current was 60/10 or 6 ma. The two voltages and frequency were then used to calculate the inductance of the coil under test.

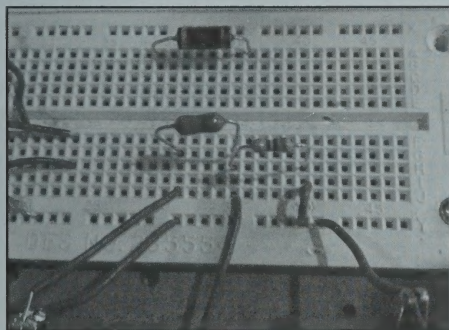


Figure 5

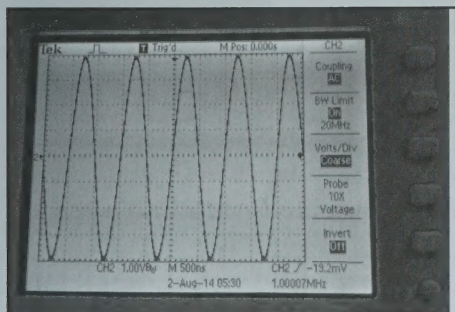


Figure 6

The theory behind this scheme is as follows. First, think of how you use a voltmeter to measure the voltage between two resistors connected in series. The cur-

rent is the same in both resistors. So, you can measure the voltage across either resistor and then calculate the current following through both.

When it comes to AC circuits, those including a capacitor and/or inductor with a resistor, things get a bit messy. Our circuit wired above includes just one 220uH coil and one 10 ohm resistor. Second, the AC impedance of a coil, called its reactance, is equal to $2\pi f$ times its inductance, also written as X_L , where X is equal to $2\pi f$, f being the frequency of operation. And here's the trick: we'll make our sensing resistor very small so that it barely affects the resulting current in the circuit. Then we can estimate the inductance (AC impedance) of the coil by first measuring the AC current through the 10 ohm sensing resistor. For our 220 uH coil, its impedance (reactance) is calculated as follows:

AC Ohms Law goes as follows: $V=X*I$,
where X is $2\pi f*L$, so $V=2\pi f*L*I$,
rearranging :

$$L = \frac{V}{2\pi fI} = \frac{8v_{pp}}{2\pi * 1MHz * 60/10ma} = 212\mu H.$$

Using ohms law and a voltmeter or scope we measure the voltage across our sensing resistor and calculate the current (which is also the current through the coil). Using the current in the circuit, the frequency of the current (and voltage applied) and the voltage across the coil (disregarding the small voltage drop across the sensing resistor), we can calculate the inductance.

Notice that this result is very close to the value printed on the part. I ran a second measurement for the 150 uH coils and got 149.8. Nice!

If you found this stuff interesting and want to look at the original 73 article, search for henryometer on the web.

10-31-14

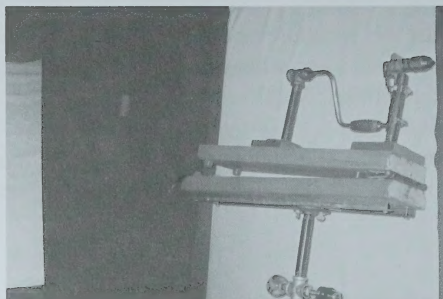
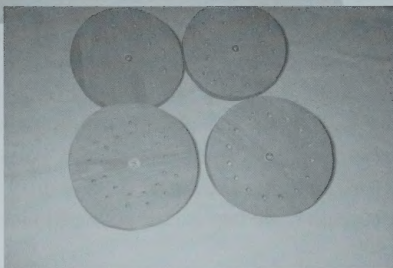
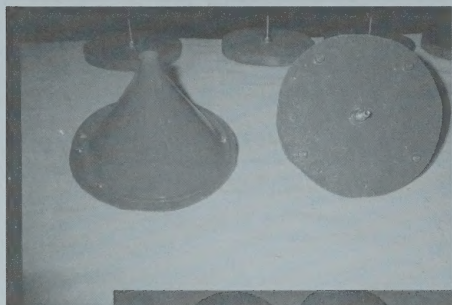
Xtal Corner: Member Correspondence

From Ken Ladd:

I had wanted to build a coil winder for many years and had a concept in mind. I had collected a few items but never seem to do anything with them. This all changed when I found some hand braces amongst my late father's tools. The one I used apparently followed him home from a farm auction in a goody box. I bought the pipe fittings and a couple of hardware items but all the rest was free.

The funnels are to be used with open end cylinders and the six inch wooden disks with salt or oatmeal boxes and the like. The wooden disks are also drilled for nails to wind a variety of basket woven coils. The 2x6 base boards are joined with a scrap door hinge to make it easier to transport or store. The hinge pin can also be pulled and sections used separately. The drill chuck section has a brake made from a scrap water valve can be used to chuck a basket weave form or the form can be fastened face up on the work bench.

The spool holder is made from scrap from work and other stuff.



From Joe Ducar:

Crystal Set Goddess, Patricia,

Finished my Spider Coil Radio Kit, thought I had a wiring problem, discovered crystal ear phone was dead on arrival.

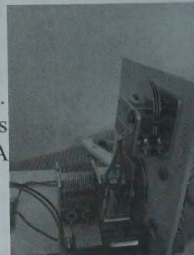
Used my usual transformer and sound powered Western Electric phones. Unit works great. Already modified it. Changed antenna tuning cap to one with a vernier, one of yours. Had to add a cap in series with the cap. My antenna length and height may be the issue with the existing circuit. (75 ft long 40ft high)

Also used one of your verniers for the main tuning cap.

These changes makes it easy to tune.

With this mod , I can tune 13 stations during day time hours! THIS IS A GREAT KIT!

May add an insulated shaft to the antenna tuner shaft.



Please tell the people there, that this set is the best I have. The My Marconi is great, but this one is better. Got a new set of sound power phones. Pickup 19 stations in the charlotte. All are loud and clear. That's with the leaves on the trees. Marconi gets 13 in the fall.

Just had to tell you again! New york City comes in here at night like it's local.

All connections are on the front panel. The switch let you change phone taps on audio transformer. Lets me use Sennheiser HD202 phones, Baldwins or sound powered Navy Western Electrics



Antenna cap is a 3 turn 90mf cap. Much easier to tune . Note your parts on the main tuning cap. (gear reduction)

Patricia

This is a Bogen taped audio transformer and tap switch.



Once again society members bring you ideas and instructions for a variety of crystal radio projects. This book contains projects and theory about crystal radio including: The Magic Reynolds Wrap Attic Antenna and instructions for building your own basket weave coil mandrel. The secret life of detectors is revealed in John Davidson's seminal article presented here with parts 1 and 2 together. 8 1/2 X 11, Comb bound. Cat # xv15 \$12.95

Just when you thought the projects were over, here's a new batch. Again society members bring you ideas and instructions for a variety of crystal radio projects. These are gathered from the 2006 & 2007 newsletters! H.P. Friedrichs introduces his "Tea Time" Headphones (constructed in a pair of little tea boxes). There's a variable-coupled basket weave coil, Dan's Fruit of the Loom Set (a basket of Litz of course), Mike's I-Tube Low Voltage DXer Set (3Q4), stuff about Toroids, Patron's Modern Armstrong Regen RX, stuff on detection, Spider coils from Dan, the Xtal High Voltage Contest Entry winner, a calibrated capacitor, Phil's Crazy-L Attic Antenna, Alex Jueschke's homebrew loopstick coils (from magnet ore sweepings), a rare picture of Joe Eisenberg of Nebraska (!), another regen rig, Phil's crazy AM Chopper Modulator, a sampling of member correspondence, and more! 8-1/2 by 11, 100 pages, Comb bound. Cat# XV17 \$15.95

Learn about using audio transformers from Phil, building a basic grid leak from Dan, and how to build a homemade flame triode from Nyle Steiner. These ideas and many others are from the 2008-2009 newsletters. In the 2009 section, you will see Dan's one-FET set, and an antenna tuner for your crystal radio. Dennis Baker shows us a radio on a stick. 8 1/2 by 11 with 118 pages, Comb Bound. XV19 \$16.95.

This edition marks 20 years of the Crystal Set Society. Many thanks to all our members for twenty years of fun with radio. The compilation includes the articles from the 2010 and 2011 newsletters, including: Fun With Homebrew Cuprous Oxide Diodes; Resistance of Hardboard; The Telefunken Crystal Set; Two Popular AM Loop Antennas; Diode Biasing; Ultrasound Pressure of a Weak Spark; The Old Timer - Regeneration; The Antenna Tutorial I, II & III; Crystal Radios Are Like Beer; A Trap Antenna; Simple Circuits for Quality Sound; Audio Regeneration; Powered by Fleming's Amazing Valve; Two JFET Crystal Sets, From the Mailbox of Prof Verruckt, The AM Antenna Tuner Kit, and more. 8-1/2 by 11 with 115 pages, Comb Bound. Cat#XV21 \$16.95.

This small booklet is written in easy to read language for the true beginner to our wonderful hobby. It has pictures and symbols for basic parts and gives the reader basic information to get started with that first building project.

ORDER FORM (5/2013)				Cat#	Qty	Price
Description						
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We accept checks, money orders, or VISA/MC						
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Orders are filled promptly, but allow 2-3 weeks for delivery						

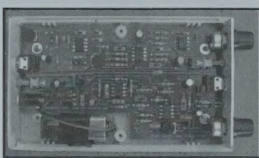
Grounding Kit



This kit is ideal for use with our Crystal Radio Antenna Kit or for general station grounding. It consists of a long-lasting 2.5 by 1/2 inch galvanized ground rod, 1/2-inch brass rod clamp, ten feet of #14 Insulated Stranded copper antenna wire and an instruction/installation sheet. The grounding kit provides for an outside grounding circuit for your crystal radio. The antenna wire is very flexible, allowing you to loop it under your window at the sill and then simply closing the window.

Grounding Kit Catalog # Grd-K \$19.95.

CW REGEN FILTER, (Alias: The Scrubber)



This kit was inspired by the inhibiting galactic noise encountered when listening to HF CW. Many proficient CW operators turn the AF gain full on and manage the audio signal and noise with internal rig filters and the RF gain knob.

Even with these techniques band-limited cosmic static is present along with some man-made noise. There isn't much one can do to copy CW notes that are simply too weak; but, one can scrub away a portion of the static that makes its way into our consciousness with an audio regenerative filter. (See the feature article on the CW Scrubber in November, 2012 CQ Magazine.)

For example, when tuned to a quiet spot on 30-meters, regen's output shows a reduction in noise compared to the signal at the phone jack of the receiver. In bypass mode one simply listens to what the rig has to offer. In scrubber mode, the multiple-op-amp filters and regen work together to remove a majority of the remaining white noise. The processed signal sounds clean with a slight echo-chamber quality. For most this is an improvement, reducing stress and improving copy.

For experienced kit makers, assembly and alignment is about two hours. You can use a meter or scope to align the filters and the audio delay line. If you have neither of these you can align the filter by ear. If you don't have a signal generator, you can use CW from your rig, a code oscillator or download 600, 700, and/or 800 Hz wavefiles from our "downloads" webpage. In addition, you'll supply the connectors and cabling for your specific radio and the following tools and supplies: pliers, cutters, knife or wire stripper, soldering iron & solder, masking tape and your enthusiasm! The filter can be supplied with a well regulated and grounded +12VDC supply or 9V battery. A well grounded station is necessary when external high gain audio-based accessories are added to prevent or substantially reduce any "ground loop" interference. The populated PCB fits in a plastic case that is W 3.700, H 1.450, and L 6.100 inches.

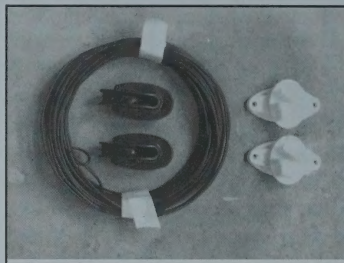
CW REGEN FILTER KIT, PCB & MANUAL ONLY 29.95

CW REGEN FILTER KIT, NO CASE 49.95

CW REGEN FILTER KIT WITH CASE 69.95

Crystal Radio Antenna Kit

This kit consists of 50 feet of #14 AWG insulated and stranded copper antenna wire, two nail insulators, two antenna insulators and an instruction and installation sheet. The instruction sheet outlines how to install the antenna for the AM band.

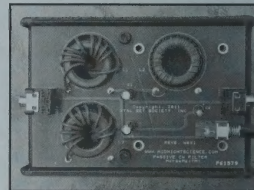


The nail insulators mount with two wood screws and provide for wire

support near the window and at a tree or eve. Weave the wire through the "claws" of the nail insulator to hold it in place. The antenna insulators may be used with rope on one side and as a tie-off for the antenna wire on the other side. These are shown in the picture inside the 50' loop of wire. Since the wire is flexible, you can easily place it on your window sill and close the window. Crystal Radio Antenna Kit Cat #Ant-k \$19.95

Passive Audio CW Filter Kit

Our Passive Audio CW Filter Kit was inspired by our enthusiasm for non-powered – no batteries or power supplies required – electronics. The kit features a 250 Hertz (Hz) bandwidth, 700 Hz center-frequency, 8-ohms in, 8-ohms out audio filter, designed for CW operation. A bypass switch allows for bypass and in-line reception comparison. The unit installs between your receiver's headphone jack and headphones or speaker. Assembly for experienced kit builders is less than an hour. The kit consists of eleven parts, including three high-mu ferrites, quality PCB and black plastic case. Instructions are included for changing the filter bandwidth to 500 Hz for CW or 1500 Hz for SSB; for either of these frequency bandwidths the number of winding per core must be changed and a different set of capacitors purchased.



The kit can accommodate other center frequencies and bandwidths. To calculate the number of turns for the cores (coils) and the capacitor values required download these files: [manual addendum](#) and [filter calculator](#) spread sheet (xls).

Passive Audio CW Filter Kit, with PCB & CASE 36.95